

BIOGRAPHICAL SKETCH

(Give the following information for all professional personnel listed on page 3, beginning with the Principal Investigator.
Use continuation pages and follow the same general format for each person.)

NAME FEIGENBAUM, Edward A.	TITLE Professor and Chairman Computer Science Department	BIRTHDATE (Mo., Day, Yr.) January 20, 1936
PLACE OF BIRTH (City, State, Country) Weehäwken, New Jersey, U.S.A.	PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date) U.S. Citizen	SEX <input checked="" type="checkbox"/> Male <input type="checkbox"/> Female

EDUCATION (Begin with baccalaureate training and include postdoctoral)

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Carnegie Institute of Technology, Pittsburgh, Pennsylvania	B.S.	1956	Electrical Engineering
Carnegie Institute of Technology, Pittsburgh, Pennsylvania	Ph.D.	1959	Industrial Administration

HONORS

MAJOR RESEARCH INTEREST Artificial Intelligence	ROLE IN PROPOSED PROJECT Principal Investigator
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RESEARCH SUPPORT (See instructions)

(See continuation page)

RESEARCH AND/OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)

1976 - present Professor (by Courtesy) Department of Psychology, Stanford University
 1976 - present Chairman, Department of Computer Science, Stanford University
 1969 - present Professor of Computer Science, Stanford University
 1965 - present Principal Investigator, Heuristic Programming Project, Stanford University
 1965 - 1968 Associate Professor of Computer Science, Stanford University
 1965 - 1968 Director, Stanford Computation Center, Stanford University
 1964 - 1965 Associate Professor, School of Business Administration,
 University of California, Berkeley
 1960 - 1963 Assistant Professor, School of Business Administration,
 University of California, Berkeley
 1961 - 1964 Research Appointment, Center for Human Learning,
 University of California, Berkeley
 1960 - 1964 Research Appointment, Center for Research in Management Science,
 University of California, Berkeley
 1968 - 1972 Member, Computer and Biomathematical Science Study Section, National
 Institutes of Health, Bethesda, Maryland
 1977 - 1978 Member, Committee on Mathematics in the Social Sciences, Social
 Science Research Council, New York, New York
 1977 - present Member, Computer Science Advisory Committee, National Science Foundation
 1979 - present Member, Advisory Committee on Mathematics in Naval Research, NRC/ONR

Professional Societies, Consultantships, Publications (see continuation pages.)

BIOGRAPHICAL SKETCH - FEIGENBAUM, Edward A.

RESEARCH SUPPORT

Grant No.	Title of Project	Funding		% of Effort	Grant Agency
		Current Year	Project Period		
MCS78-02777	MOLGEN: A Computer Science Application to Molecular Genetics	\$153,959 (12/79-11/80)	\$294,476 (6/78-3/81)	5	NSF
1 P01 LM 03395-01	Research Program; Biomedical Knowledge Representation	\$ 99,484 (7/79-6/80)	\$497,420 (7/79-6/84)	10	NLM
MDA 903- 80-C-0107	Heuristic Programming Project	\$496,256 (10/79-9/80)	\$1,613,588 (10/79-9/82)	25	ARPA
MCS 7923666	The Automation of Scientific Inference: Heuristic Computing Applied to Protein Crystallography	\$54,469 (12/79-11/81)	\$54,469 (12/79-11/81)	0	NSF

BIOGRAPHICAL SKETCH - FEIGENBAUM, Edward A.

PROFESSIONAL SOCIETIES

American Association for Artificial Intelligence (President-Elect, 1979-80)
Cognitive Science Society (member, Governing Board, 1979-)
American Psychological Association
American Association for the Advancement of Science
Association for Computing Machinery (member of National Council of ACM, 1966-68)

CONSULTANTSHIPS

Information Sciences Institute of University of Southern California
The RAND Corporation
Schlumberger, Inc.
Jaycor, Inc.

BOOKS AND MONOGRAPHS

Handbook of Artificial Intelligence, co-editor with A. Barr, (in final preparation).
Computers and Thought, co-editor with Julian Felman, McGraw-Hill, 1963.
Information Processing Language V Manual, Englewood Cliffs, N.J., Prentice-Hall, 1961 (with A. Newall, F. Tonge, G. Mealy et al).
An Information Processing Theory of Verbal Learning, Santa Monica, The RAND Corporation Paper P-1817, October 1959 (Monograph)

SOME RECENT AND SELECTED PAPERS:

Edward H. Shortliffe, Bruce G. Buchanan, Edward A. Feigenbaum, "Knowledge Engineering For Infectious Disease Therapy Selection" in Proceedings of the IEEE, Vol. 67, No. 9, September 1979.

L. Fagan, J. Kunz, E. Feigenbaum, CSD Stanford University
J.J. Osborn from PMC, San Francisco
"Knowledge Engineering for Dynamic Clinical Settings: Giving Advice in the Intensive Care Unit," submitted to Sixth International Conference on Artificial Intelligence, 1979, February 1979.

E. H. Shortliffe, B.G. Buchanan, E. A. Feigenbaum, "Knowledge Engineering for Medical Decision Making: A Review of Computer-Based Clinical Decision Aids," appeared in the Proceedings of the IEEE, September 1979.

J.C. Kunz, R.J. Fallat, D.H. McClung, J.J. Osborn, B.A. Votteri, H.P. Nii, J.S. Aikins, L.M. Fagan, E.A. Feigenbaum, "A Physiological Rule Based System for Interpreting Pulmonary Function Test Results," Stanford Heuristic Programming Project Memo (144) HPP-78-19.

B.G. Buchanan and E.A. Feigenbaum, "DENDRAL and Meta-DENDRAL: Their Applications Dimension," Artificial Intelligence, 11(1,2)5(1979). (Also Stanford Heuristic Programming Project Memo (126) HPP-78-1).

BIOGRAPHICAL SKETCH -- FEIGENBAUM, Edward A.
PUBLICATIONS (continued)

Feigenbaum, E.A.: The Art of Artificial Intelligence: I. Themes and Case Studies of Knowledge Engineering. Proceedings of the IJCAI, 1977.

Feigenbaum, E.A., Englemore, R.S. and Johnson, C.K.: A Correlation between Crystallographic Computing and Artificial Intelligence Research. Acta Cryst., A33 (Jan 1): 13-18, 1977. (Also Stanford Heuristic Programming Project Memo (102) HPP-77-15.)

Nii, H.P. and Feigenbaum E.A.: Rule-based Understanding of Signals. Proceedings of the Conference on Pattern-directed Inference Systems, 1977. (Also Stanford Heuristic Programming Project Memo (94) HPP-77-7 and Computer Science Department Memo STAN-CS-77-612.)

Feigenbaum, E.A.: Computer Applications: Introductory Remarks. IN Proceedings of Federation of American Societies for Experimental Biology 33, 2331 (1974) also IN W. Siler and D.A.E. Lindberg (Eds.) Computers in Life Science Research, Plenum Press, 49-51 (1975). (Also Stanford Heuristic Programming Project Memo (57) HPP-74-4.)

Buchanan, B.G., Feigenbaum E.A. and Sridharan, N.S.: Heuristic Theory Formation; Data Interpretation and Rule Formation. IN Machine Intelligence 7, Edinburgh University Press (1972). (Also Stanford Heuristic Programming Project Memo (38) HPP-72-2.)

Buchanan, B.G., Feigenbaum, E.A. and Lederberg, J.: A Heuristic Programming Study of Theory Formation in Science. IN Proceedings of the Second International Joint Conference on Artificial Intelligence, Imperial College, London (September, 1971). (Also Stanford Artificial Intelligence Project Memo No. 145, and Heuristic Programming Project Memo (35) HPP-71-4.)

Feigenbaum, E.A., Buchanan, B.G. and Lederberg, J.: On Generality and Problem Solving: A Case Study Using the DENDRAL Program. IN B. Meltzer and D. Michie (Eds.) Machine Intelligence 6, Edinburgh University Press (1971). (Also Stanford Artificial Intelligence Memo No. 131, Heuristic Programming Project Memo (30) HPP-70-5, and Computer Science Memo STAN-CS-176.)

Feigenbaum, E.A.: Artificial Intelligence: Themes in the Second Decade. IN Final Supplement to Proceedings of the IFIP 68 International Congress, Edinburgh, August 1968. (Also Stanford Artificial Intelligence Project Memo No. 67, August 1968, and Heuristic Programming Project Memo (11) HPP-67-3.)

Lederberg, J. and Feigenbaum, E.A.: Mechanization of Inductive Inference in Organic Chemistry. IN B. Kleinmuntz (Ed.), Formal Representations for Human Judgment (Wiley, 1968). (Also Stanford Artificial Intelligence Project Memo No. 54, August 1967, and Heuristic Programming Project Memo (11) HPP-67-3.)

BIOGRAPHICAL SKETCH

(Give the following information for all professional personnel listed on page 3, beginning with the Principal Investigator. Use continuation pages and follow the same general format for each person.)

NAME GENESERETH, Michael R.	TITLE Acting Assistant Professor Computer Science	BIRTHDATE (Mo, Day, Yr.) October 15, 1948	
PLACE OF BIRTH (City, State, Country) Philadelphia, Pennsylvania, U.S.A.	PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date) U.S. Citizen	SEX <input checked="" type="checkbox"/> Male <input type="checkbox"/> Female	
EDUCATION (Begin with baccalaureate training and include postdoctoral)			
INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Massachusetts Institute of Technology	B.S.	1972	Physics
Harvard University	M.S.	1974	Computer Science
Harvard University	Ph.D.	1978	Applied Mathematics
HONORS			

MAJOR RESEARCH INTEREST Computer Science/Artificial Intelligence	ROLE IN PROPOSED PROJECT Core research
RESEARCH SUPPORT (See instructions)	

(see continuation page)

RESEARCH AND/OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)

1979 - present Acting Assistant Professor, Department of Computer Science,
Stanford University

1978 - 1979 Research Associate and co-Group Leader, Department of Electrical
Engineering and Computer Science, M.I.T.

1973 - 1978 Research Assistant, Department of Electrical Engineering and
Computer Science, M.I.T.

1971 - 1973 Programmer, Mathlab Group, M.I.T.

PUBLICATIONS (see continuation page)

BIOGRAPHICAL SKETCH -- GENESERETH, Michael R.

RESEARCH SUPPORT

Grant No.	Title of Project	Funding		% of Effort	Grant Agency
		Current Year	Project Period		
MDA 903-80-C-0107	Heuristic Programming Project	\$496,256 (10/79-9/80)	\$1,613,588 (10/79-9/82)	10	ARPA
MCS-7903753	Knowledge-Based Consultation Systems	\$ 73,659 (7/79-6/80 + 6 months)	\$ 73,659 (7/79-6/80 + 6 months)	33	NSF
1PO1 LM 03395-01	Biomedical Knowledge Representation	\$ 99,484 (7/79-6/80)	\$497,420 (7/79-6/84)	32	NLM

Selected Papers:

- "The Role of Plans in Intelligent Teaching Systems"
 - in *Intelligent Teaching Systems*, edited by Derek Sleeman, Academic Press, 1980.
 - STAN-CS-784, Stanford Computer Science Dept, Mar. 1980.
- "The Use of Semantics in a Tablet-Based Program for Selecting Parts of Mathematical Expressions"
 - in Proc. of the Second MACSYMA Users' Conference, M.I.T., June 1979.
- "The Canonicity of Rule Systems"
 - in Proc. of the European Symposium on Symbolic and Algebraic Manipulation, Springer-Verlag, June 1979.
- "Artificial Intelligence Techniques in MACSYMA"
 - in *AI Handbook*, edited by Feigenbaum and Barr.
- "Automated Consultation for Complex Computer Systems"
 - doctoral dissertation, Harvard University, Nov. 1978.
- "The Difficulties of Using MACSYMA and the Functions of User Aids"
 - Proc. of the First MACSYMA Users' Conference, June 1977.
- "A Fast Inference Algorithm for Semantic Networks"
 - Memo No. 4, M.I.T. Mathlab Group, 1977.

Invited Talks:

- "An Automated Consultant for MACSYMA"
 - Stanford Research Institute, April 1979.
 - University of Maryland, April 1979.
 - Worcester Polytechnic Institute, Jan. 1979.
 - M.I.T., Apr. 1978.
- "The Role of Plans in Automated Tutors and Consultants"
 - Harvard University, Nov. 1978.
- "Algebraic Simplification Using MACSYMA"
 - White Sands Missile Range, July 1978.
 - Sigma Xi Lecture, David W. Taylor Naval Ship R&D Center, Feb. 1978.
- "The Simplification of Mathematical Expressions"
 - Los Alamos Scientific Laboratory, July 1978.

BIOGRAPHICAL SKETCH

(Give the following information for all professional personnel listed on page 3, beginning with the Principal Investigator.
Use continuation pages and follow the same general format for each person.)

NAME	TITLE	BIRTHDATE (Mo., Day, Yr.)
GILMURRAY, Frank S.	System Programmer	July 20, 1948
PLACE OF BIRTH (City, State, Country)	PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date)	SEX
Brooklyn, New York, U.S.A.	U.S. Citizen	<input checked="" type="checkbox"/> Male <input type="checkbox"/> Female

EDUCATION (Begin with baccalaureate training and include postdoctoral)

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Polytechnic Institute of Brooklyn, New York	B.S.	1970	Electrical Engineering
University of Pittsburgh, Pennsylvania Graduate School (1970-71)	None	--	Computer Science

HONORS

MAJOR RESEARCH INTEREST	ROLE IN PROPOSED PROJECT
Operating Systems	System Programmer
RESEARCH SUPPORT (See instructions)	

RESEARCH AND/OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)

1977 - present System Programmer, SUMEX Computer Project,
 Department of Genetics, Stanford University School of Medicine

1976 - 1977 System Programmer, On-Line Systems, Inc., Pittsburgh, Pennsylvania

1971 - 1976 System Programmer, Computer Center, University of Pittsburgh

PUBLICATIONS (none)

BIOGRAPHICAL SKETCH

(Give the following information for all professional personnel listed on page 3, beginning with the Principal Investigator.
Use continuation pages and follow the same general format for each person.)

NAME LENAT, Douglas B.	TITLE Assistant Professor Computer Science	BIRTHDATE (Mo., Day, Yr.) September 13, 1950
PLACE OF BIRTH (City, State, Country) Philadelphia, Pennsylvania, U.S.A	PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date) U.S. Citizen	SEX <input checked="" type="checkbox"/> Male <input type="checkbox"/> Female

EDUCATION (Begin with baccalaureate training and include postdoctoral)

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
University of Pennsylvania	B.A.	1972	Mathematics
University of Pennsylvania	B.A.	1972	Physics
University of Pennsylvania	M.S.	1972	Applied Mathematics
Stanford University	Ph.D.	1976	Computer Science

HONORS

MAJOR RESEARCH INTEREST

ROLE IN PROPOSED PROJECT

Computer Science/Artificial Intelligence

Core Research

RESEARCH SUPPORT (See instructions)

(see continuation page)

RESEARCH AND/OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)

1979 - present Consultant to IBM Yorktown, on Maurice Karnaugh's Automatic Programming Effort

1978 - present Assistant Professor, Computer Science Department, Stanford University

1978 Instructor at General Electric's Program for Modern Managers, Saratoga Springs, N.Y.

1978 - present Consultant to Schlumberger Oil Co., Ridgefield, Conn.

1978 - present Consultant to Xerox-PARC's Systems Science Laboratory, Palo Alto, Calif.

1977 - present Consultant to NIH, as member of their Special Study Section on Biotechnology Resources

1977 Consultant to BBN, Boston, on John Seely Brown's CAI project

1976 - 1978 Assistant Professor, Computer Science Department Carnegie-Mellon University

1976 - present Consultant to RAND Corp., Santa Monica, Ca., on their "Intelligent Terminal" project

PUBLICATIONS (see continuation page)

BIOGRAPHICAL SKETCH - LENAT, Douglas B.

RESEARCH SUPPORT

Grant No.	Title of Project	Funding		% of Effort	Grant Agency
		Current Year	Project Period		
1PO1 LM 03395-01	Research Program: Biomedical Knowledge Representation	\$ 99,484 (7/79-6/80)	\$497,420 (7/79-6/84)	10	NLM
MCS78- 02777	MOLGEN: A Computer Science Application to Molecular Genetics	\$153,959 (12/79-11/80)	\$294,476 (6/78-3/81)	20	NSF
MDA 903-80- C-0107	Heuristic Programming Project	\$496,256 (10/79-9/80)	\$1,613,588 (10/79-9/82)	20	ARPA

Published Papers

- [1] *Progress Report on Program-Understanding Systems*, Memo AIM-240, CS Report STAN-CS-74-444, Artificial Intelligence Laboratory, Stanford University, August, 1974. Co-authored with Green, Waldinger, Barstow, Elshlager, McCune, Shaw, and Steinberg.
- [2] *Synthesis of Large Programs from Specific Dialogues*, Proceedings of the International Symposium on Proving and Improving Programs, IRIA, Le Chesnay, France, July, 1975.
- [3] *Duplication of Human Actions by an Interacting Community of Knowledge Modules*, Proceedings of the Third International Congress of Cybernetics and Systems, Bucharest, Romania, August, 1975.
- [4] *BEINGS: Knowledge as Interacting Experts*, Proceedings of the Fourth International Joint Conference on Artificial Intelligence, Tbilisi, USSR, September, 1975.
- [5] *AM: An Artificial Intelligence Approach to Discovery in Mathematics as Heuristic Search*, Ph.D. Thesis, Stanford A. I. Lab Memo Memo AIM-286, CS Report No. STAN-CS-76-570, and Heuristic Programming Project Report HPP-76-8, Stanford University, July, 1976.
- [6] *Designing a Rule System That Searches for Scientific Discoveries*, (Lenat and Harris), invited paper for the conference in Honolulu, May, 1977; published in (Hayes-Roth and Waterman, eds.) Proceedings of the Conference on Pattern-Directed Inference, Academic Press, 1977. Also issued as a CMU technical report, April, 1977.
- [7] *Automated Theory Formation in Mathematics*, Fifth IJCAI, Cambridge, Mass., August, 1977.
- [8] *Less Than General Production System Architectures*, (Lenat and J. McDermott,) Fifth IJCAI, Cambridge, Mass., August, 1977.
- [9] *The Ubiquity of Discovery*, the 1977 Computers and Thought Lecture (invited talk at the Fifth IJCAI). Preliminary version published in the proceedings of that conference; final version printed in the Journal of A.I. Repeated as an invited talk at NCC (Anaheim, June, 1978).
- [10] *On Automated Scientific Theory Formation: A Case Study Using the AM Program*, invited paper presented at the Ninth Machine Intelligence workshop in Leningrad, USSR, April, 1977. Forthcoming publication in (Michie, ed.) Machine Intelligence 9, 1978.
- [11] Programs that Acquire Expert Knowledge: Two AI Approaches, (Davis & Lenat), McGraw Hill, 1978.
- [12] *Pattern Directed Inference Rules the Waves*, Journal of the AISB (Artificial Intelligence Society of Britain), October, 1977, 8-12. Reprinted in SIGART, 1978.
- [13] *Rule Based Computation: Some Syntheses*, (Hayes-Roth, Waterman, and Lenat), concluding chapter for (Hayes-Roth and Waterman, eds.) Proceedings of the Conference on Pattern-Directed Inference, Academic Press, 1977.
- [14] *Artificial Intelligence and Natural Statistics*, invited paper at "Computer Science and Statistics: Eleventh Annual Symposium on the Interface", University of North Carolina at Raleigh, March 6, 1978.
- [15] Unscripted interview on AI & Problem Solving, broadcast over the BBC, as part of the Open University's 32 week course on Cognitive Psychology. Taped at CMU on Feb. 22, 1978, by Clive Holloway, Open University, Milton Keynes, England.
- [16] *On Astrophysics and Superhuman Performance* (an invited commentary), Journal of the Behavioral and Brain Sciences, Vol. 1, No. 1, 1978..ss(Societies/committees/awards)

BIOGRAPHICAL SKETCH

(Give the following information for all professional personnel listed on page 3, beginning with the Principal Investigator.
Use continuation pages and follow the same general format for each person.)

NAME LEVINTHAL, Elliott C.	TITLE Adjunct Professor of Genetics Dir., Instrumentation Res. Lab.	BIRTHDATE (Mo., Day, Yr.) April 13, 1922
PLACE OF BIRTH (City, State, Country) Brooklyn, New York, U.S.A.	PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date) U.S. citizen	SEX <input checked="" type="checkbox"/> Male <input type="checkbox"/> Female

EDUCATION (Begin with baccalaureate training and include postdoctoral)

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Columbia College, New York	B.A.	1942	Physics
Massachusetts Institute of Technology	M.S.	1943	Physics and Math
Stanford University	Ph.D.	1949	Physics and Math

HONORS

Public Service Medal, awarded by NASA, April, 1977, for exceptional contributions to the success of the Viking project

MAJOR RESEARCH INTEREST Medical instrumentation research	ROLE IN PROPOSED PROJECT AIM Liaison
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RESEARCH SUPPORT (See instructions)

Funding

Grant No.	Title of Project	Current Year	Project Period	% of Effort	Grant Agency
NSG 7538	Mars Data Analysis	\$102,689 (10/79-9/80)	\$144,781 (4/79-9/80)	50%	NASA

RESEARCH AND/OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)

1974 - present Adjunct Professor, Department of Genetics, Stanford University,
Director, Instrumentation Research Laboratory,
Department of Genetics, Stanford University

1970 - 1973 Associate Dean for Research Affairs,
Stanford University School of Medicine

1961 - 1974 Senior Scientist/Director, Instrumentation Research Laboratories,
Department of Genetics, Stanford University

1953 - 1961 President, Levinthal Electronic Products

1952 - 1953 Chief Engineer, Century Electronics

1950 - 1952 Research Director/Member of Board of Directors, Varian Associates

1949 - 1950 Research Physicist, Varian Associates

1946 - 1948 Research Associate, Nuclear Physics, Stanford University

1943 - 1946 Project Engineer, Sperry Gyroscope Company, New York

1943 Teaching Fellow in Physics, Massachusetts Institute of Technology

PUBLICATIONS (See continuation page)

BIOGRAPHICAL SKETCH - LEVINTHAL, Elliott C.
PUBLICATIONS (Selected)

1. Levinthal, E.C., Lederberg, J. and Hundley, L.: Multivator - A Biochemical Laboratory for Martian Experiments. Life Sciences and Space Research II, COSPAR (Committee on Space Research), 1964.
2. Halpern, B., Westley, J.W., Levinthal, E.C. and Lederberg, J.: The Pasteur Probe: An Assay for Molecular Asymmetry. Life Sciences and Space Research, COSPAR (Committee on Space Research), 1966.
3. Levinthal, E.C.: Space Vehicles for Planetary Missions. In Biology and the Exploration of Mars, Nat. Acad. Sci., National Research Council.
4. Levinthal, E.C.: Prospects for Manned Mars Missions. In Biology and the Exploration of Mars, Nat. Acad. Sci., National Research Council.
5. Levinthal, E.C., Lederberg, J. and Sagan, C.: Relationship of Planetary Quarantine to Biological Search Strategy. Presented at COSPAR Meeting (Committee on Space Research), London, 1967.
6. Sagan, C., Levinthal, E.C. and Lederberg, J.: Contamination of Mars. Science 159:1191-1196, 1968.
7. Levinthal, E.C.: The Role of Molecular Asymmetry in Planetary Biological Exploration. Presented at Gordon Research Conferences, Nuclear Chemistry Section, 1968.
8. Mutch, T.A., Binder, A.B., Huck, F.O., Levinthal, E.C., Morris, E.C., Sagan, C. and Young, A.T.: Imaging Experiment. Icarus 16:92, 1972.
9. Levinthal, E.C., Green, W.B., Cuts, J.A., Jahelka, E.D., Johnsen, R.A., Sander, M.J., Seidman, J.B., Young, A.T. and Soderblom, L.A.: Mariner 9 - Image Processing and Products. Icarus 18:1088, 1973.
10. Sagan, C., Veverka, J., Fox, P., Dubisch, R., French, R., Gierasch, P., Quam, L., Lederberg, J., Levinthal, E., Tucker, R., Eross, E. and Pollack, J.B.: Variable Features on Mars, 2, Mariner 9 Global Results. J. Geophysical Research 78, No. 20, p. 4163-4196, 1973.

BIOGRAPHICAL SKETCH - LEVINTHAL, Elliott C.
PUBLICATIONS (continued)

11. Lederberg, J., Feigenbaum, E., Levinthal, E. and Rindfleisch, T.: SUMEX - A Resource for Application of Artificial Intelligence in Medicine. Proc. Ann. Conference, Association for Computing Machinery, November, 1974.
12. Levinthal, E.C., Carhart, R.E., Johnson, S.M. and Lederberg, J.: When Computers Talk to Each Other. Industrial Research 17(12):35-42, 1975.
13. Mutch, T.A., Binder, A.B., Huck, F.O., Levinthal, E.C., Liebes, S., Morris, E.C., Patterson, W.R., Pollack, J.B., Sagan, C. and Taylor, G.R.: The Surface of Mars: The View from the Viking I Lander. Science 193(4255):791-801, 1976.
14. Mutch, T.A., Arvidson, R.E., Binder, A.B., Huck, F.O., Levinthal, E.C., Liebes, S., Morris, E.C., Nummedal, D., Pollack, J.B. and Sagan, C.: Fine Particles on Mars: Observations with the Viking I Lander Cameras. Science 194(4260): 87-91, 1976.
15. Mutch, T.A., Arvidson, R.E., Aurin, P., Binder, A.B., Huck, F.O., Levinthal, E.C., Liebes, S., Morris, E.C., Pollack, J.B., Sagan, C. and Saunders, R.: The Surface of Mars: The View from Lander 2. Science 194(4271):1277-1283, 1976.
16. Levinthal, E.C., Green, W., Jones, K.L. and Tucker, R.: Processing the Viking Lander Camera Data. Jour. Geophys. Res., No. 28, 30 Sept. 1977.
17. Levinthal, E.C., Jones, K.L., Fox, P. and Sagan, C.: Lander Imaging as a Detector of Life on Mars. Jour. Geophys. Res. 82, No. 28, 30 Sept. 1977.

BIOGRAPHICAL SKETCH

(Give the following information for all professional personnel listed on page 3, beginning with the Principal Investigator.
Use continuation pages and follow the same general format for each person.)

NAME NII, H. Penny	TITLE Research Associate Computer Science	BIRTHDATE (Mo., Day, Yr.) October 6, 1939
PLACE OF BIRTH (City, State, Country) Tokyo, Japan	PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date) U.S. Citizen	SEX <input type="checkbox"/> Male <input checked="" type="checkbox"/> Female

EDUCATION (Begin with baccalaureate training and include postdoctoral)

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Tufts University, Jackson College Medford, Massachusetts	B.S.	1962	Mathematics
Stanford University	M.A.	1973	Computer Science

HONORS

MAJOR RESEARCH INTEREST Knowledge-based computer systems design	ROLE IN PROPOSED PROJECT Core Research
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RESEARCH SUPPORT (See instructions)

Funding

Grant No.	Title of Project	Current Year	Project Period	% of Effort	Grant Agency
MDA 903-80- C-0107	Heuristic Programming Project	\$496,296 (10/79-9/80)	\$1,613,588 (10/79-9/82)	20	ARPA

RESEARCH AND/OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)

1977 - present Research Associate, Heuristic Programming Project,
Department of Computer Science, Stanford University

1976 - 1977 Scientific Programmer, Heuristic Programming Project,
Department of Computer Science, Stanford University

1973 - 1975 Associate Investigator for Computer Science, HASP Project,
Systems Control, Inc., Palo Alto, California

1967 - 1968 Systems Engineering Advisor, International Business Machines Corporation,
Tokyo, Japan

1962 - 1967 Research Staff Programmer. International Business Machines Corporation,
Thomas J. Watson Research Center.

1965-67 Project Leader, Electronic Coding Pad (ECP) System

1965-66 Assistant Manager, Man-Computer Interaction Group

1963-64 Programmer, World's Fair Lexical Processing System

1962-63 Programmer, applications ranging from text processing
to linear programming problems

RECENT PUBLICATIONS (See continuation page)

RECENT PUBLICATIONS

Nii, H. P. and Aiello, N., "AGE: A Knowledge-based Program for Building Knowledge-based Programs," Proc. of IJCAI-6, 1979, pp.645-655.

Kunz, J.C., Fagan, L.M., Fallat, R.J., McClung, D.H., Aikins, J.S., Nii, H.P., Feigenbaum, E.A., Osborn, J.J., "Use of Artificial Intelligence for Interpretation of Physiological Measurements: Pulmonary Function Diagnosis and I.C.U. Ventilator Management," (to be published); abstract in Proc. of NCC, 1978, pp. 260-261.

Nii, H.P. and Feigenbaum E.A., "Knowledge-based Understanding of Signals", in Pattern-Directed Inference Systems, D.A. Waterman and F. Hayes-Roth (eds.), NY: Academic Press, 1978.

Engelmore, R.A. and Nii, H.P., "A Knowledge-based System for the Interpretation of Protein X-ray Crystallographic Data", Heuristic Programming Project Memo; HPP-77-2, (also STAN-CS-77-589), January 1977.

Feigenbaum, E.A., Nii, H.P., et al., "HASP (Heuristic Adaptive Surveillance Program) Final Report, Vols. I-IV, Technical Report under ARPA Contract M66314-74-C-1235, Systems Control, Inc., Palo Alto, CA., 1975 (Classified document).

BIOGRAPHICAL SKETCH

(Give the following information for all professional personnel listed on page 3, beginning with the Principal Investigator.
Use continuation pages and follow the same general format for each person.)

NAME	TITLE	BIRTHDATE (Mo., Day, Yr.)
RINDFLEISCH, Thomas C.	Senior Research Associate	December 10, 1941
PLACE OF BIRTH (City, State, Country)	PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date)	SEX
Oshkosh, Wisconsin, U.S.A.	U.S. citizen	<input checked="" type="checkbox"/> Male <input type="checkbox"/> Female

EDUCATION (Begin with baccalaureate training and include postdoctoral)

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Purdue University, Lafayette, Indiana	B.S.	1962	Physics
California Institute of Technology, Pasadena	M.S. Ph.D.	1965 Thesis to be completed; all course work and examinations completed.	Physics

HONORS

Graduated with Highest Honors, Purdue University
NSF Fellowship, Caltech
Sigma Xi

MAJOR RESEARCH INTEREST	ROLE IN PROPOSED PROJECT
Computer science applications in medical research; image processing and artificial intelligence	Facility Manager

RESEARCH SUPPORT (See instructions)

RESEARCH AND/OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)

Stanford University:

1978 - present Senior Research Associate, Computer Science Department
1976 - present Senior Research Associate, Genetics Department, School of Medicine
1974 - present Director, SUMEX Computer Project, Genetics Department
1971 - 1976 Research Associate, Genetics Department:
1974 - 1976 SUMEX Computer Project
1971 - 1976 Mass Spectrometry, Instrumentation Research Labs.

Jet Propulsion Laboratory, California Institute of Technology, Pasadena:

1969 - 1971 Supervisor, Image Processing Development and Applications Group
1968 - 1969 Mariner Mars 1969 Cognizant Engineer for Image Processing
1962 - 1968 Engineer, design and implement image processing computer software

PUBLICATIONS (see continuation page)

PUBLICATIONS

1. Rindfleisch, T. and Willingham, D.: A Figure of Merit Measuring Picture Resolution. JPL Technical report 32-666, September, 1965.
2. Rindfleisch, T.: A Photometric Method for Deriving Lunar Topographic Information. JPL Technical Report 32-786, September, 1965.
3. Rindfleisch, T. and Willingham, D.: A Figure of Merit Measuring Picture Resolution. Advances in Electronics and Electron Physics, Vol. 22A, Photo-Electronic Image Devices, Academic Press, 1966.
4. Rindfleisch, T.: Photometric Method for Lunar Topography. Photogrammetric Engineering, March, 1966.
5. Rindfleisch, T.: Generalizations and Limitations of Photoclinometry. JPL Space Science Summary, Vol. III, 1967.
6. Rindfleisch, T.: The Digital Removal of Noise from Imagery. JPL Space Science Summary 37-62, Vol. III, 1970.
7. Rindfleisch, T.: Digital Image Processing for the Rectification of Television Camera Distortions. Astronomical Use of Television-Type Image Sensors. NASA Special Publication SP-256, 1971.
8. Rindfleisch, T., Dunne, J., Frieden, H., Stromberg, W. and Ruiz, R.: Digital Processing of the Mariner 6 and 7 Pictures. J. Geophysical Research, Vol. 76, No. 2, January, 1971.
9. Pereira, W.E., Summons, R.E., Reynolds, W.E., Rindfleisch, T.C. and Duffield, A.M.: The Quantitation of Beta-Aminoisobutyric Acid in Urine by Mass Fragmentography. Clinica Chimica Acta, 49, 1973.
10. Summons, R.E., Pereira, W.E., Reynolds, W.E., Rindfleisch, T.C. and Duffield, A.M.: Analysis of Twelve Amino Acids in Biological Fluids by Mass Fragmentography. Analytical Chemistry, Vol. 46, No. 4, April, 1974.
11. Pereira, W.E., Summons, R.E., Rindfleisch, T.C. and Duffield, A.M.: The Determination of Ethanol in Blood and Urine by Mass Fragmentography. Clin. Chim. Acta, 51, 1974.
12. Pereira, W.E., Summons, R.E., Rindfleisch, T.C., Duffield, A.M., Zeitman, B. and Lawless, J.G.: Stable Isotope Mass Fragmentography: Quantitation and Hydrogen-Deuterium Exchange Studies of Eight Murchison Meteorite Amino Acids. Geochem. et Cosmochim. Acta, 39, 163, 1975.

BIOGRAPHICAL SKETCH - RINDFLEISCH, Thomas C.

PUBLICATIONS (continued)

13. Dromey, R.G., Stefik, M.J., Rindfleisch, T.C. and Duffield, A.M.: Extraction of Mass Spectra Free of Background and Neighboring Component Contributions from Gas Chromatography/Mass Spectrometry Data. *Analytical Chemistry*, 48, 1368, 1976.
14. Smith, D.H., Achenbach, M., Yeager, W.J., Anderson, P.J., Fitch, W.L. and Rindfleisch, T.C.: Quantitative Comparison of Combined Gas Chromatographic/Mass Spectrometric Profiles of Complex Mixtures. *Anal. Chem.*, 49, 1623, 1977.
15. Smith, D.H., Rindfleisch, T.C. and Yeager, W.J.: Exchange of Comments: Analysis of Complex Volatile Mixtures by a Combined Gas Chromatography-Mass Spectrometry System. *Anal. Chem.*, 50, 1585, 1978.
16. Rindfleisch, T.C. and Smith, D.H.: Chapter 3. In G.R. Waller (Ed.) *Biomedical Applications of Mass Spectrometry*. (in press)

BIOGRAPHICAL SKETCH

(Give the following information for all professional personnel listed on page 3, beginning with the Principal Investigator. Use continuation pages and follow the same general format for each person.)

NAME SHORTLIFFE, Edward H.	TITLE Assistant Professor Medicine Computer Science (by courtesy)	BIRTHDATE (Mo., Day, Yr.) August 28, 1947
PLACE OF BIRTH (City, State, Country) Edmonton, Alberta, Canada	PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date) U.S. Citizen	SEX <input checked="" type="checkbox"/> Male <input type="checkbox"/> Female

EDUCATION (Begin with baccalaureate training and include postdoctoral)

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Harvard College, Cambridge, Massachusetts	B.A.	1970	Applied Math and Computer Science
Stanford University School of Medicine	Ph.D.	1975	Med. Info. Sciences
Stanford University School of Medicine	M.D.	1976	

HONORS

(see continuation page)

MAJOR RESEARCH INTEREST Computer-based Medical Consultation Systems	ROLE IN PROPOSED PROJECT Co-Principal Investigator
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RESEARCH SUPPORT (See instructions)

(see continuation page)

RESEARCH AND/OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)

1979 - present Assistant Professor (by courtesy), Department of Computer Science,
Stanford University, Stanford, California

1979 - present Assistant Professor of Medicine (General Internal Medicine)
Stanford University School of Medicine, Stanford, California

1977 - 1979 Resident in Medicine, Stanford University School of Medicine

1976 - 1977 Intern in Medicine, Massachusetts General Hospital, Boston, Mass.

1971 - 1975 Doctoral Research, Medical Scientist Training Program,
Stanford University School of Medicine, Stanford, California

1970 - 1971 Research assistant, Drug Interaction (MEDIPHOR) Project,
Stanford University School Of Medicine, Stanford, California

PUBLICATIONS (see continuation page)

BIOGRAPHICAL SKETCH - SHORTLIFFE, Edward H.

HONORS

Graduation Magna Cum Laude, Harvard College, June, 1970.

Medical Scientist Training Program, Traineeship, September 1971 - June 1976.

Grace Murray Hopper Award (Distinguished computer scientist under age 30),
Association for Computing Machinery, October 1976.

Recipient of Research Career Development Award, National Library of Medicine,
July 1979 - present.

RESEARCH SUPPORT

Grant No.	Title of Project	Funding		% of Effort	Grant Agency
		Current Year	Project Period		
NLM LM03395	Research Program: Biomedical Knowledge Representation	\$ 99,484 (7/79-6/80)	\$497,420 (7/79-6/84)	50	NLM
----	Explanatory Patterns In Clinical Medicine	\$ 20,000 (7/79-12/80)	\$ 20,000 (7/79-12/80)	25	KAISER
To support the 75% research time above:					
NLM LM00048	Symbolic Computation Methods for Clinical Reasoning (RCDA)	\$ 39,285 (7/79-6/80)	\$196,425 (7/79-6/84)	—	NLM

BIOGRAPHICAL SKETCH - SHORTLIFFE, Edward H.
PUBLICATIONS (Selected)

BOOK

Shortliffe, E.H. Computer-Based Medical Consultations: MYCIN , Elsevier/
North Holland, New York, 1976.

JOURNAL ARTICLES

Shortliffe, E.H., Axline, S.G., Buchanan, B.G., Merigan, T.C., and Cohen,
S.N. "An artificial intelligence program to advise physicians regarding
antimicrobial therapy". Comput. Biomed. Res. 6:544-560 (1973).

Shortliffe, E.H. and Buchanan, B.G. "A model of inexact reasoning in
medicine." Math. Biosci. 23:351-379 (1975).

Shortliffe, E.H., Davis, R., Axline, S.G., Buchanan, B.G., Green, C.C., and
Cohen, S.N. "Computer-based consultations in clinical therapeutics:
explanation and rule-acquisition capabilities of the MYCIN system."
Comput. Biomed. Res. 8:303-320 (1975).

Davis, R., Buchanan, B.G., and Shortliffe, E.H. "Production rules as an
approach to knowledge-based consultation systems." Artificial
Intelligence 8:15-45 (1977).

Scott, A.C., Clancey, W., Davis, R., and Shortliffe, E.H. "Explanation
capabilities of knowledge-based production systems." Amer. J.
Computational Linguistics, Microfiche 62, 1977. Also available as TR
HPP-77-1, Heuristic Programming Project, Stanford University, March
1977.

Wraith, S.M., Aikins, J.S., Buchanan, B.G., Clancey, W.J., Davis, R., Fagan,
L.M., Hannigan, J.F., Scott, A.C., Shortliffe, E.H., vanMelle, W.J., Yu,
V.L., Axline, S.G., and Cohen, S.N. "Computerized consultation system
for selection of antimicrobial therapy." Amer. J. Hosp. Pharm.
33:1304-1308 (1976).

Yu, V.L., Buchanan, B.G., Shortliffe, E.H., Wraith, S.M., Davis, R., Scott,
A.C., Axline, S.G., and Cohen, S.N. "Evaluating the performance of
a computer-based consultant." Comput. Prog. Biomed.
9:95-102 (1979).

Shortliffe, E.H., Buchanan, B.G., and Feigenbaum, E.A. "Knowledge
engineering for medical decision making: A review of computer-based
clinical decision aids." Proceedings of the IEEE, 67:1207-1224 (1979).

Shortliffe, E.H. "The computer as clinical consultant" (editorial).
Arch. Int. Med. 140:313-314 (1980).

Fagan, L.M., Shortliffe, E.H., and Buchanan, B.G. "Computer-based medical
decision making: from MYCIN to VM." Automedica, 3:97-106 (1980).

BIOGRAPHICAL SKETCH

(Give the following information for all professional personnel listed on page 3, beginning with the Principal Investigator.
Use continuation pages and follow the same general format for each person.)

NAME	TITLE	BIRTHDATE (Mo., Day, Yr.)
SWEER, Andrew J.	System Programmer	March 12, 1945
PLACE OF BIRTH (City, State, Country)	PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date)	SEX
Washington, D.C., U.S.A.	U.S. citizen	<input checked="" type="checkbox"/> Male <input type="checkbox"/> Female

EDUCATION (Begin with baccalaureate training and include postdoctoral)

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
University of Pittsburgh, Pennsylvania	B.S.	1965	Mathematics
University of Pittsburgh, graduate school (1965-66)	None	--	Mathematics, Computer Science

HONORS

MAJOR RESEARCH INTEREST

Operating systems

ROLE IN PROPOSED PROJECT

System Programmer

RESEARCH SUPPORT (See instructions)

RESEARCH AND/OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)

1976 - present Head System Programmer, SUMEX Computer Project,
Department of Genetics, Stanford University

1974 - 1975 Senior Systems Designer, ILLIAC IV Project,
Evans and Sutherland

1970 - 1974 Systems Analyst Supervisor, Computer Center,
University of Pittsburgh

1968 - 1969 Computer Specialist, Office of Personnel Operations,
Department of the Army, Headquarters the Pentagon

1966 - 1968 Systems Programmer/Analyst, Computer Center,
University of Pittsburgh

PUBLICATIONS (none)

BIOGRAPHICAL SKETCH

(Give the following information for all professional personnel listed on page 3, beginning with the Principal Investigator.
Use continuation pages and follow the same general format for each person.)

NAME TUCKER, Robert B.	TITLE System Programmer	BIRTHDATE (Mo., Day, Yr.) June 12, 1940
PLACE OF BIRTH (City, State, Country) Seattle, Washington, U.S.A.	PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date) U.S. Citizen	SEX <input checked="" type="checkbox"/> Male <input type="checkbox"/> Female

EDUCATION (Begin with baccalaureate training and include postdoctoral)

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Stanford University	B.S.	1962	Mathematics

HONORS

MAJOR RESEARCH INTEREST Network Communications Digital Image Processing RESEARCH SUPPORT (See instructions)	ROLE IN PROPOSED PROJECT System Programmer
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RESEARCH AND/OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)

Department of Genetics, Stanford University School of Medicine:
1977 - present System Programmer, SUMEX Computer Project
1965 - 1977 Scientific Programmer, Instrumentation Research Laboratories

PUBLICATIONS (see continuation pages)

BIOGRAPHICAL SKETCH - TUCKER, Robert B.

PUBLICATIONS

- Tucker, Robert B. "A Mass Spectrometer Data Acquisition and Analysis System." Stanford Inst. Res. Lab. Tech. Report IRL-1063, NASA CR-94919, CFSTI Accession N-68-25743, 1968.
- Reynolds, W., Bridges, J., Tucker, R. and Coburn, T. "Computer Control of Mass Analyzers." 16th Annual Conference on Mass Spectrometry and Allied Topics, ASTM Committee E-14, NASA CR-96821, 1968.
- Reynolds, W., Bacon, V., Bridges, J., Coburn, T., Halpren, B., Lederberg, J., Levinthal, E., Steed, E., and Tucker, R. "A Computer Operated Mass Spectrometer System." Analytical Chemistry, vol 42, pp 1122-1129, Sept. 1970.
- Quam, L., Liebes, S., Tucker, R., Hannah, M., and Eross, B., "Computer Interactive Picture Processing." Stanford Artificial Intelligence Project Memo. AIM-166." 1972.
- Sagan, C., Veverka, J., Fox, P., Dubisch, R., Lederberg, J., Levinthal, E., Quam, L., Tucker, R., Pollack, J. and Smith, B. "Variable Features on Mars: Preliminary Mariner 9 Television Results." Icarus, vol 17, pp 346-372, 1972.
- Quam, L., Tucker, R., Eross, B., Veverka J. and Sagan, C. "Mariner 9 Picture Differencing at Stanford." Sky and Telescope, vol 46 no. 2, August 1973.
- Sagan, C., Veverka, J., Fox, P., Dubisch, R., French, R., Gierasch, P., Quam, L., Lederberg, J., Levinthal, E., Tucker, R., Eross, B. and Pollack, J. "Variable Features on Mars, 2, Mariner 9 Global Results." Journal of Geophysical Research, vol 70, no. 20, pp 4163-4196, 1973.
- Veverka, J., Sagan, C., Quam, L., Tucker, R. and Eross, B. "Variable Features on Mars III: Comparison of Mariner 1969 and Mariner 1971 Photography." Icarus, vol 21, pp 317-368, 1974.
- Sagan, C., Veverka, J., Steinbacher, R., Quam, L., Tucker, R. and Eross, B. "Variable Features on Mars IV. Pavonis Mons." Icarus, vol 22, pp 24-47, 1974.
- Veverka, J., Noland, M., Sagan, C., Pollack, J., Quam, L., Tucker, R., Eross, B., Duxbury, T. and Green, W. "A Mariner 9 Atlas of the Moons of Mars." Icarus, vol 23, no. 2, pp 206-289, 1974.
- Veverka, J., Sagan, C., Quam, L., Tucker, R. and Eross, B. "The Changing Surface of Mars." Astronomy, vol 3, no. 6, June 1975.
- Mutch, T. A., et al. "The Surface of Mars: The View from the Viking 2 Lander." Science, vol 194, pp 1277-1283, 17 Dec. 1976.